

# Evaluating Status and Trends in Fecal Pollution in Puget Sound

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## Abstract

Procedures used by the Washington State Department of Health to classify shellfish beds were adapted to evaluate status and trends in fecal pollution impact. The analysis for the year ending 2001 included status of 95 shellfish growing areas in Puget Sound and the straits of Georgia and Juan de Fuca. A fecal pollution index (FPI) was developed to estimate impact from fecal pollution. Sixty-four areas showed negligible impact (FPI was 1.00 or less). Thirty-one areas show significant impact (FPI was greater than 1.00). The affected areas were ranked by the FPI. Trend analysis showed evidence of improvement in several growing areas following focused and rigorous remedial action.

The Washington State Department of Health (DOH) monitors bio-toxins in shellfish from Washington state waters to protect shellfish consumers from harm. Each year, DOH analyzes spatial and temporal trends in Paralytic Shellfish Poisoning (PSP) toxin for the Puget Sound Ambient Monitoring Program (PSAMP). Status and trends have been analyzed for 10 years of data. For the year ending 2001, PSP levels measured in mussels from 34 Sentinel Monitoring Sites in Puget Sound and the straits of Georgia and Juan de Fuca were sorted into four impact categories (none-high). Twenty-four sites had at least minimal impact. A PSP Impact Factor (based on duration of PSP incident) was used to rank impact. Sites in Hood Canal, Totten Inlet (south Puget Sound), and Westcott Bay (San Juan Islands) were free of PSP in 2001.

## Background

In recent decades, Puget Sound shellfish have been contaminated by fecal sources from adjacent uplands. Stakeholders needed to see whether source control programs worked. The procedure mandated by the National Shellfish Sanitation Program (NSSP) to classify shellfish beds for harvest was adapted to measure status and detect trends in fecal pollution in marine waters. Results suggest relationship between upland pollution sources and marine pollution.

## NSSP Criteria

The NSSP criteria used to in part to classify shellfish are as follows:

**Criterion 1:** Fecal coliform levels in samples shall not exceed a geometric mean value of 14 organisms per 100ml.

**Criterion 2:** The estimated ninetieth percentile of fecal coliform samples shall not exceed 43 MPN per 100ml.

A minimum of 30 previously collected results is needed to calculate the criteria. Both criteria must be met in order to meet the growing area standard. It is important to note that a shellfish area is not classified on the basis of the water quality criteria alone. An area cannot be approved for harvest if a detailed inspection of adjacent shoreline and uplands reveals significant pollution threats, even if marine waters meet the water quality criteria.

## Analytical Approach

The following analytical approach was used:

1. Only continually sampled stations were used for the analysis.
2. The analysis included all stations, including those closed for harvest by DOH.
3. NSSP statistics (geometric mean and 90<sup>th</sup> percentile) were calculated from the earliest date with 30 prior results. Statistics were similarly calculated for each date through December 2001.
4. Ninetieth percentiles were used for status and trends analysis because they were more sensitive to pollution changes.
5. Trends were tested with Spearman's *rho* (a nonparametric test based on ranks).

## Results

Figure 1 summarizes status of nearly 100 classified shellfish growing areas in Puget Sound, and the Straits of Georgia and Juan de Fuca (U.S. jurisdiction). For each growing area, 90<sup>th</sup> percentiles from all stations for all dates were sorted into categories of **GOOD**, **FAIR**, or **BAD**. A pie chart for each growing area shows the fraction of 90<sup>th</sup> percentiles in each category. (The status of **Mats Mats Bay** and **Saltwater State Park** (Nos. 19 and 31, respectively on Figure 1) were estimates based on statistics calculated from fewer data than specified by the NSSP procedure.)

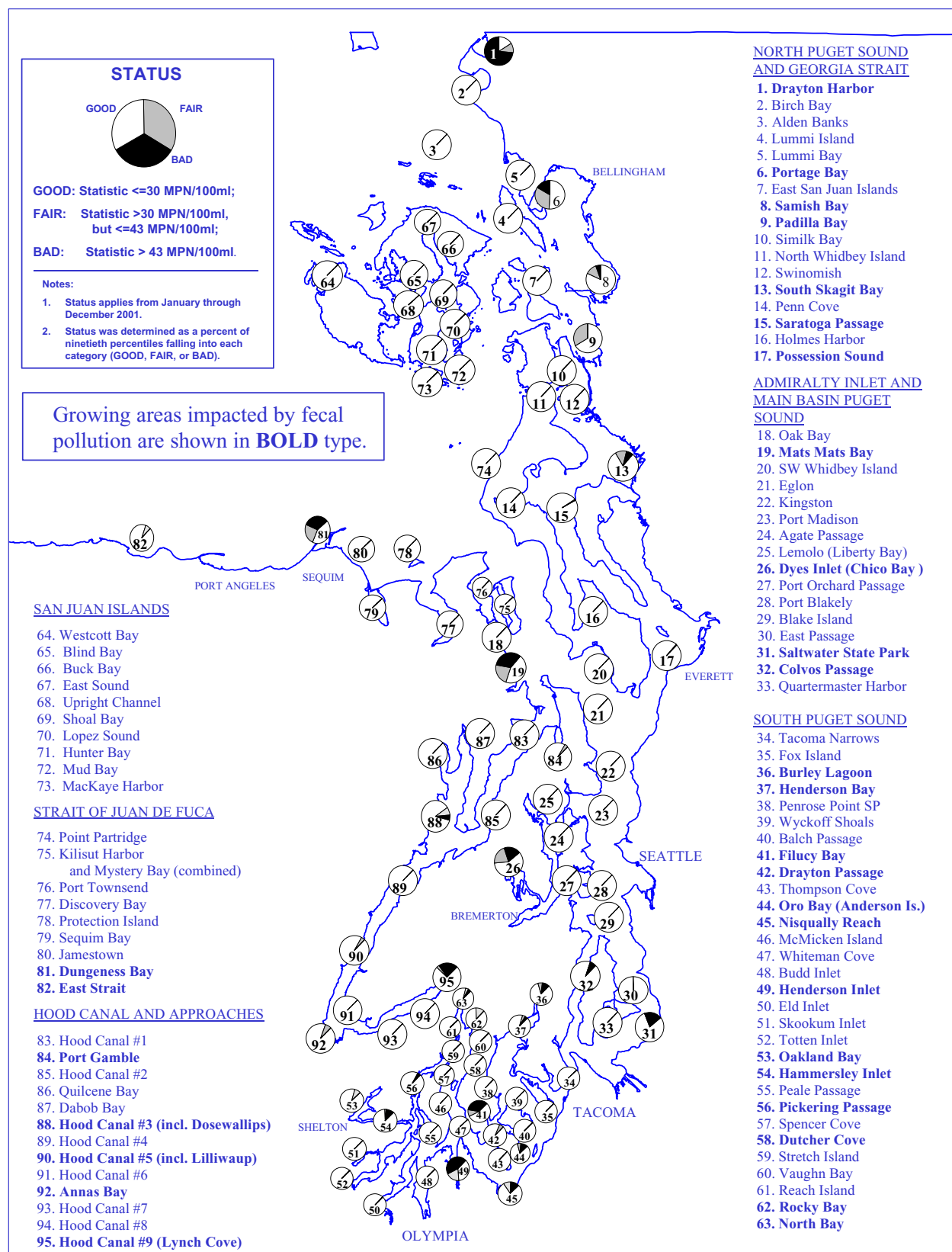
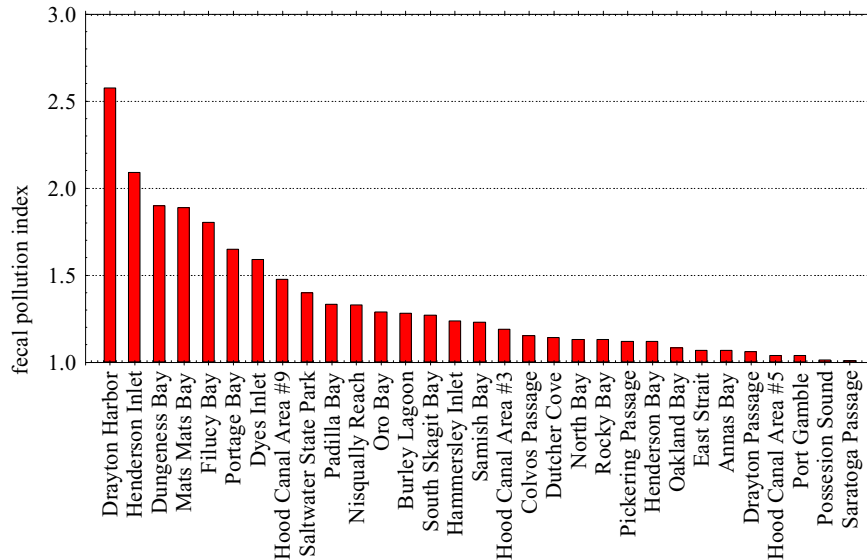


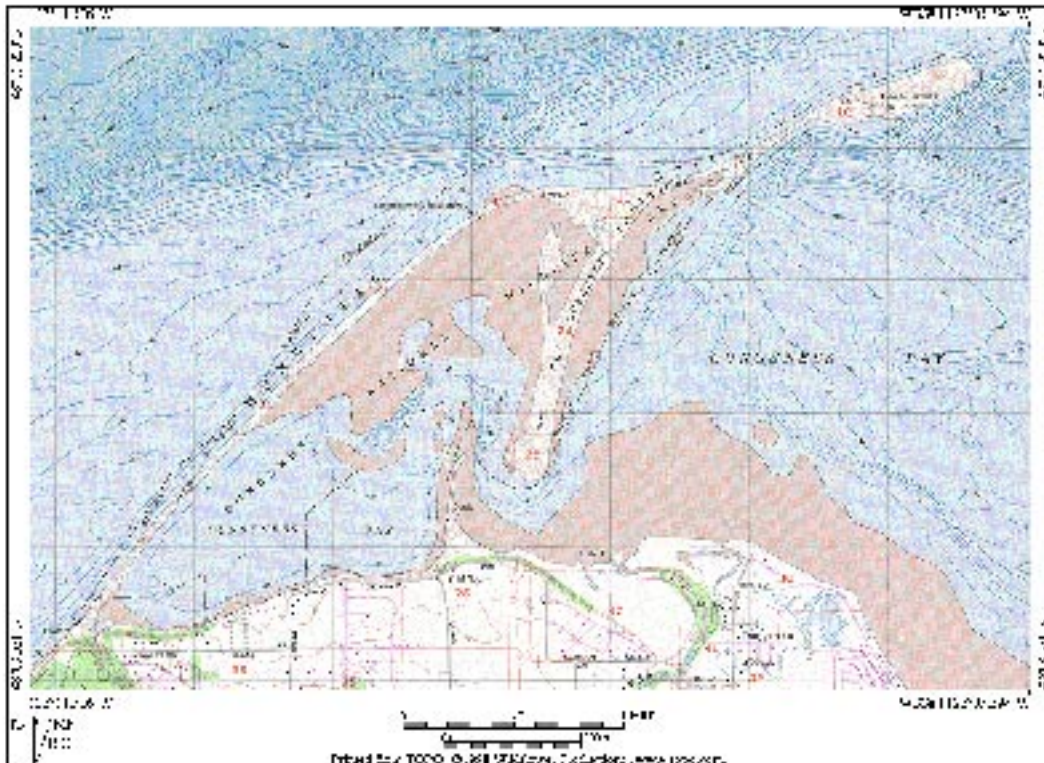
Figure 1. Status of fecal pollution in Puget Sound in 2001.

Figure 2 shows the ranking of shellfish growing areas in calendar year 2001 according to fecal pollution impact. The fraction of 90th percentiles in each category was multiplied by a “weighting factor” (GOOD=1; FAIR=2; BAD=3). The weighted values were then combined to produce a Fecal Pollution Index for each growing area. The resulting indices were finally sorted according to the value of the fecal pollution index. A qualitative comparison of Figure 1 with Figure 2 shows agreement.



**Figure 2.** Rank of Puget Sound growing areas by fecal pollution impact in 2001.

Results in Figure 3 suggest decreasing gradient of fecal impact radiating outward from Dungeness River. Subsequent Trend at most stations is increasing.



**Figure 3.** Status and trends at Dungeness Bay through 2001.

## Summary

Nearly 1200 sampling stations in 96 commercial growing areas were evaluated for status and trends for calendar year 2001. Nearly 90% of stations were **GOOD**; 4% were **FAIR**, and 5% were **BAD**. The 90th percentiles in nearly two-thirds of growing areas were all **GOOD**. The remaining areas were mixed **GOOD**, **FAIR** and **BAD** (see Figure 1). The impacted growing areas were ranked according to fecal pollution indices (see Figure 2). A brief “status and trends” summary was prepared for each impacted growing area for concerned stakeholders (for an example, see Figure 3).